

Three new species of *Argiolestes*, with a key to the males of *Argiolestes* s. str. (Odonata: Megapodagrionidae)

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ABSTRACT

In this article the genus *Argiolestes* s.str. is defined and three new species belonging to this group are described: *A. foja* sp. nov. (holotype: Foja Mountains, Indonesia, dep. in MBBJ); *A. muller* sp. nov. (holotype: Baia River, Papua New Guinea, dep. in SAMA); *A. roon* sp. nov. (holotype: Roon Island, Indonesia, dep. in BPBM). New records for *A. alfurus* are given, a key to males is presented and a map of the distribution of the species is shown. Both sexes of *A. muller* and the male of *A. roon* are depicted in life. The group is distributed from New Guinea over the Moluccas to Sulawesi. As far as is known all species are confined to forest brooks.

INTRODUCTION

The genus *Argiolestes* currently includes 48 species found on New Caledonia, the Solomon Islands, the Bismarck Archipelago, New Guinea and adjacent smaller islands, the Moluccas, Sulawesi and Luzon. Most of these were described by Liefstinck (1935, 1938, 1949, 1956) but recently, renewed interest in the genus has led to the description of several additional species (Englund & Polhemus 2007; Kalkman 2007, 2008a; Theischinger & Richards 2006, 2007, 2008; Michalski & Oppel 2010). VJK is working on a revision of the genus, for which several new genera will ultimately be established. The current article focuses on *Argiolestes* sensu stricto for which the type is *A. australis* (Guérin-Méneville, 1830).

In this article we define the characters of the genus *Argiolestes* s.str. and provide information on all known species including new distribution records for *A. alfurus*. Three new species are described. We present a key to males of all species.

MATERIAL AND METHODS

Terminology largely follows Watson & O'Farrell (1991).

Acronyms for collections are as follows:

BPBM Bernice P. Bishop Museum, Honolulu, Hawaii, USA

MBBJ Museum Zoologicum Bogoriense, Cibining, Java, Republic of Indonesia

RMNH Nationaal Natuurhistorisch Museum Naturalis, Leiden, The Netherlands

SAMA South Australian Museum, Adelaide, Australia

ZMA Zoologisch Museum Amsterdam, The Netherlands

DEFINITION OF *Argiolestes* s.str.

Adult males of species included in *Argiolestes* s.str. are well differentiated from other species of *Argiolestes* s.l. and related Australasian genera by having a pale, in life whitish or pale bluish, posterior portion of S10 and pale appendages. These contrast with the darker S8-9. This character is only visible in mature individuals, ie. not in teneral, and is more pronounced in living individuals. Unfortunately, females of most species are unknown but in all known cases, S10 is pale contrasting with the darker S8-9, which suggests that the females of the group can be recognized by the same character. The pale S10 and appendages are also visible in the female of *A. muller* shown in Plate IIb. Additional characters setting *Argiolestes* s.str. apart from other species of *Argiolestes* s.l. and related genera are:

- The two apical horns of the genital ligula are slender and at least three times as long as broad (genital ligula of *A. australis* and *A. pallidistylus* unknown) (Fig. 1).
- The outer edge of the superior appendages bears several large spines (except *A. celebensis*) (Fig. 2). These spines are absent or smaller in other species of *Argiolestes* s.l.
- Each superior appendage possesses an inner basal flange (except *A. celebensis* and *A. tuberculiferus*) (Fig. 2).

Argiolestes alfurus Liefstinck, 1956

New records

13 ♂, 3 ♀, Indonesia, North Moluccas, Bacan, Gunung Sibela, tributary Ake Wayaua (0.7166°S, 127.5833°E; 840-1,000 m), natural clearing in primary forest, 30 vi - 04 vii 1985, leg. F.G. Rozendaal, RMNH; 2 ♂, 1 ♀ with the remark: shallow fast stream; 1 ♀, same data but 750 m, 03 vii 1985.

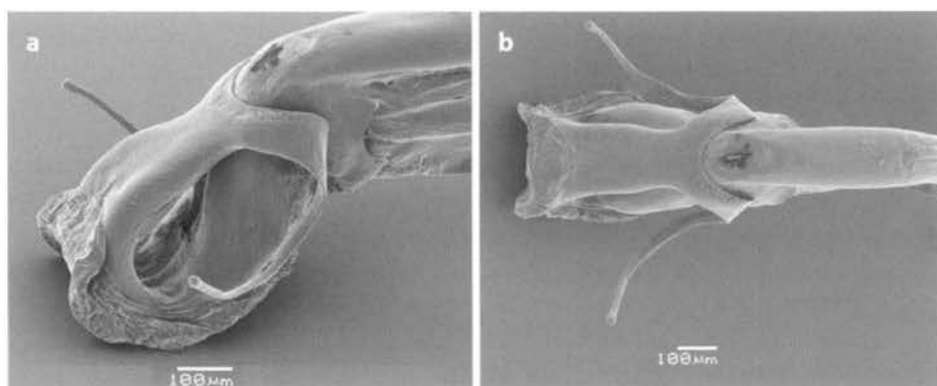


Figure 1: SEM photographs of the genital ligula of *Argiolestes amphistylus* — (a) lateral; (b) ventral.

***Argiolestes amphistylus* Lieftinck, 1949**

(Figs 1, 2a, 3a)

This species was described by Lieftinck (1949) based on four males from the Snow Mountains. The only other known record is of two males from Borme 150-200 km to the east (Kalkman 2008b). The superior appendages of the latter specimens show some small differences from the type series and have a higher number of spines on the outside of the superior appendages (Fig 2a). More specimens are needed in order to assess the taxonomic relevance of these differences.

***Argiolestes foja* sp. nov.**

(Figs 2b, 3b)

Etymology

Named after the mountain range where the species occurs. A noun in apposition.

Specimens studied

Holotype ♂: Indonesia, Papua Province, Kabupaten Sarmi (2.575°S, 138.715°E, 1,650 m), Pegunungan Foja (Foja Mountains), CI-RAP Mamberamo-Foja, leg. H. van Mastrigt 23 xi - 07 xii 2005, deposited in MBBJ.

The holotype is a badly damaged subadult. However the appendages are well preserved and should allow easy identification of future specimens. Female unknown.

Differential diagnosis

The male can be distinguished from all other species of *Argiolestes* s.str. based on the blue pattern on the face, the inferior appendages being more than half the length of the superior appendages, and, when seen in ventral view, the tip of the inferior appendages broadened and ending in a triangular area with an anteriorly-directed hook (Fig. 3b). Female unknown.

Male holotype

Head: Labium pale brown throughout; wider (1.2 mm) than long (1.0 mm), median cleft a quarter of length of labium and ca 2/3 as wide as deep. Labrum shining pale brown with a faint blue gloss; mandibles, genae and clypeus shining pale brown, but probably blue in life. Dorsum of head darker matt brown.

Thorax: Coloration of the thorax poorly preserved. Prothorax dark, hind margin of simple shape; front of synthorax largely dark with a paler longitudinal streak on centre of mesanepisternum, sides of synthorax dark with barely discernible blue pattern. — Legs with coxae and trochanters pale brown; some black near knees. Inner side of femora not flattened. Spines brown, darker than legs. Femora of first, second, and third pair of legs with respectively 7, 7, and 11 spines on the outer side. Tibiae of first pair of legs with four large and eight small spines on outer side; tibiae of second and third pair of legs with nine and seven spines on the outer side respectively; these spines are ca 3x as long as space between spines basally but become increasingly shorter towards tarsus. — Fw and Hw hyaline. Venation brown to black. Fw and Hw of equal length. One Fw with 2 and one with 3 Ax; Fw with 20–21 Px; Hw with 2 Ax and 19–20 Px. Arculus slightly distal to level of Ax2; discoidal cell in Fw long, costal side almost twice as long distal side, most acute angle ca 40°. Ac closer to Ax1 than to Ax2. One to two cells between discoidal cell and subnodus. Pt pale brown. No cells beyond Pt divided. Mostly one cell row between anal vein and hind margin of Hw, but a few cells doubled. Fields between IR2 and R3, between R3 and IR3, and between IR3 and R4 at distal end, each containing 3 or more rows of cells.

Abdomen: S1–6 largely pale brown, the posterior 1/6 of each segment darkened; S7–9 dark brown to black. S10 pale brown, with the same colour as the superior appendages and, together with these, forming a paler tip to the abdomen. Hind margin of S10 without spines, the mid-dorsal posterior half of S10 slightly raised, forming a crest. Superior appendages as in Figure 2b. Both superior and inferior appendages pale brown; inferiors more than half the length of superiors. Basal flange of superior appendages ca 1/3 of the length of appendages. Inner border of basal flange nearly straight and the basal flanges of both superior appendages running nearly parallel if tips very slightly overlap. The lower apical flange of superior appendages simple and evenly rounded, the upper flange simple, rounded, with

ca 10 black, blunt denticles. The outer margin of superior appendages with three to four moderately large subterminal blackish spines. Inferior appendages largely covered by the superior appendages seen in dorsal view, and, when seen in ventral view, the tip of the inferior appendages broadened and ending in a triangular area with an anteriorly-directed hook (Fig. 3b). Penis poorly visible but lateral axis of genital ligula long and slender.

Measurements [mm]: Total length 40, abdomen 31, Fw 27; Pt in Fw 1.2 (costal length), 1.6 (greatest length); Pt in Hw 1.4 (costal length), 1.8 (greatest length).

Argiolestes macrostylis Ris, 1913

Specimens studied

Total 1 ♂, holotype (juvenile), Indonesia, New Guinea, Lorentz River territ., Bivak islet, leg. H.A. Lorentz 14-28 ix 1909, second South New Guinea expedition, ZMA.

The species was described based on a crushed teneral male with badly distorted terminal appendages. The female of *A. macrostylis* was described by Ris (1915) based on a female collected at Kloofbivak by G.M. Versteeg during the third South New Guinea expedition, less than 100 km upstream along the Lorentz River from the type locality. *A. macrostylis* and *A. muller* are the only species of *Argiolestes* s.str. with a pair of large, well-defined marks on the front of synthorax. Although not mentioned in the original description the genital ligula of the holotype is visible although distorted. It has two long curled apical horns typical for *Argiolestes* s.str.

Argiolestes muller sp. nov.

(Figs 2c, 3c, Plate II)

Etymology

Named after the Muller Range in the vicinity of which the holotype was collected. A noun in apposition.

Specimens studied

Holotype ♂: Papua New Guinea, Western Province, small tributary of Baia River (6.0205°S, 142.5473°E; 328 m), 16 ii 2008 leg. SJR, deposited in SAMA Database No. 07-000983. — Additional specimens: 5 ♂, Papua New Guinea, Western Province, Muller Range, Gugusu camp (5.729°S, 142.263°E, 515 m), 05-11 ix 2009 leg. VJK, SJR, Muller Range expedition, RMNH.

The description below is based on the male holotype. This is the same specimen which is shown on Plate IIa. The specimen is poorly preserved and much of the pattern on the face and thorax is hardly visible. Information on colour pattern is therefore partly based on the photograph of the living insect. A teneral female photographed at the type locality (Baia River), is presumed to be the female of *A. muller* (Plate IIb). The pale S10 and the pale superior appendages show that it belongs to the *australis*-group. The pair of large, well-defined marks on front of the synthorax corresponds with that found in the male and is, with the exception of *A. macrostylis*, not present in any other species of *Argiolestes* s.str. The additional specimens became available very recently and were not used for the species description. They correspond very closely to the type specimen and confirm the information given on coloration.

Differential diagnosis

The male can be distinguished from all other species of *Argiolestes* s.str. except *A. macrostylis* by the large, well-defined mark on front of the synthorax. It can be distinguished from *A. macrostylis* by (1) the blunt, interiorly directed tubercle at the end of the basal flange of the superior appendages and (2) the lower apical flange of the superior appendages is more strongly expanded interiorly, forming a more or less triangular area (more rounded in *A. macrostylis*).

Male holotype

Head: Labium pale brown with the anterior third shiny dark brown to black; wider (1.3 mm) than long (1.0 mm), median cleft a quarter of length of labium and ca 2/3 as wide as deep. Front of face, including labrum, mandibles, genae, clypeus

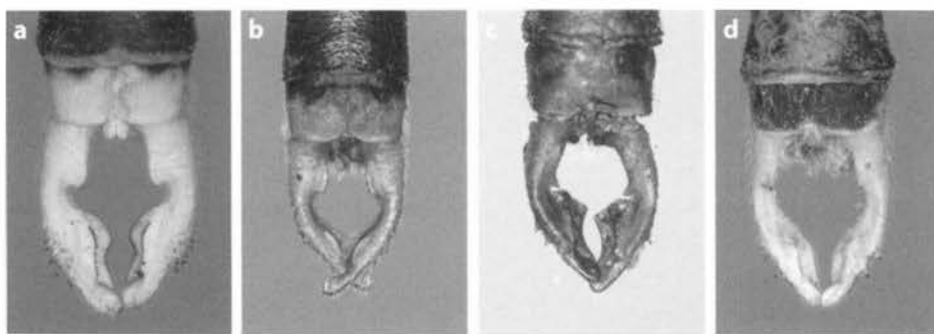


Figure 2: Superior appendages of *Argiolestes* males, dorsal view — (a) *A. amphistylus*; (b) *A. foja*; (c) *A. muller*; (d) *A. roon*.

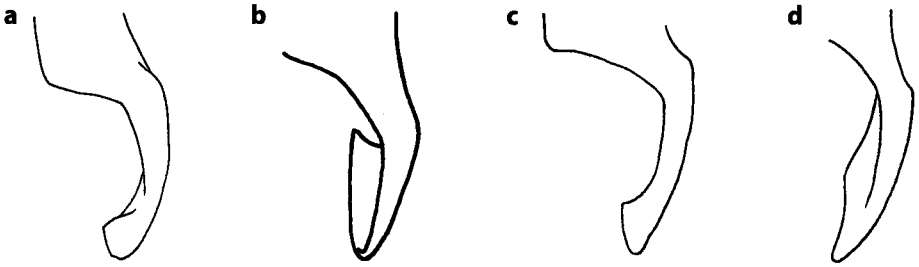


Figure 3: Inferior appendages of *Argiolestes* males, ventral view — (a) *A. amphistylus*; (b) *A. foja*; (c) *A. muller*; (d) *A. roon*. The base of the inferior appendages of *A. foja* and *A. roon* was poorly visible due to dirt and is therefore not depicted.

and sockets of antennae blue grey but bright blue in life (Plate IIa); anteclypeus slightly darker, and lower posterior corner of genae black. The blue grey colour extends along the margin of the eye; remainder of head including antennae dull black.

Thorax: Prothorax brown throughout, anterior lobe of pronotum slightly paler. Posterior lobe of pronotum low but raised at the sides and abruptly depressed in the middle; rim with long pale hairs. Ground colour of synthorax black with a clear pattern as shown on Plate IIa; pattern grey-brown in the studied specimen but blue when alive. — Coxae mottled brown, trochanters pale brown, femora pale brown but black at the knees and with a black stripe laterally. Inner side of femora not flattened. Tibiae and tarsi dark brown to black; spines black. The femora of first, second, and third pair of legs with respectively 10, 8, and 13 spines on outer side. Tibiae of first pair of legs with five large and seven small spines on outer side; tibiae of second and third pair of legs with 13 and 12–13 spines on outer side respectively; basal spines ca 3x as long as space between spines but spines becoming increasingly shorter towards tarsus. — Fw and Hw hyaline. Venation black. Fw and Hw of equal length and all with 2 Ax. Fw with 22–24 Px; Hw with 20–22 Px. Arculus distal to level of Ax2; discoidal cell in Fw very long, costal side ca three times as long as distal side, most acute angle ca 40°. Ac closer to Ax1 than to Ax2. One to two cells between discoidal cell and subnodus. Pt pale brown. A few to all cells beyond Pt divided. Up to three rows of cells between anal vein and hind margin of Hw. Fields between IR2 and R3, between R3 and IR3, and between IR3 and R4 containing each three or more rows of cells distally.

Abdomen: S1 dark brown, S2 with posterior half and sides dark brown, remainder pale brown, S3–S6 pale brown with dark ring covering the anterior fifth and a dark dorsal mark, S7–S10 largely dark brown with only hind margin of S10 slightly paler. As can be seen on Plate IIa, the hind margin of S10 was white when the specimen was alive and this would probably be visible in better-preserved speci-

mens. Hind margin of S10 without spines and slightly depressed in the middle. Epiproct upturned and prominent in dorsal view. Superior appendages as in Figure 2c. Both superior and inferior appendages brown but white in life; inferiors more than half the length of superiors. Basal flange of superior appendages ca 2/5 the length of superior appendages and ending in a blunt interiorly directed tubercle. Lower apical flange of superior appendages strongly interiorly expanded forming a more or less triangular area. Upper flange far less prominent and visible mainly due to a row of black blunt denticles. The apical part of the lower apical flange is divided from the apex of the appendages by a deep incision. Outer border of superior appendages bears one or two moderately large spines. Inferior appendages largely hidden by superiors as viewed from above and consisting of a slender axis, which broadens towards the apex (Fig. 3c). Penis not studied.

Measurements [mm]: Total length 42, abdomen 34, Fw 26; Pt in Fw 1.3 (costal length), 1.9 (greatest length); Pt in Hw 1.5 (costal length), 2.0 (greatest length).

Ecological notes

The holotype was collected from low vegetation (less than 2 m high) along a small, shallow brook in primary lowland rainforest. The female in Plate IIb was photographed within 5 m of the male. The brook was narrow, not exceeding 3 m in width at the type locality, and the clear water was flowing strongly through a series of small pools and shallow riffles. Both specimens observed were perched on leaves within 2 m of the water's edge in dappled sunlight on a warm, sunny morning. The brook is a small un-named tributary of the Baia River, which it enters several hundred metres downstream from the type locality. The additional specimens were collected in a distance of ca 50 km from the type locality at a series of small seepages and brooks at ca 500 m on the southern slopes of the Muller Range. The species was not uncommon but efforts to find larvae were unsuccessful.

Argiolestes roon sp. nov.

(Figs 2d, 3d, 4, Plate IIIa)

Etymology

Named after the island where the holotype was collected. A noun in apposition.

Specimens studied

Holotype ♂: Indonesia, West Papua Province, Roon Island, west coast, stream north of Waar village (2.37491°S, 134.510722°E, 0-40 m, water temperature 26°C), leg. DAP 12 xi 2008, on alcohol, deposited in BPBM. — Additional specimens: 2



Figure 4: Genital ligula of *Argiolestes roon*.

♂, Indonesia, West Papua Province, Kabupaten Teluk Wondama, Mioswaar, Pantai Barat, Waprak (2.1114°S, 134.3453°E), 18-27 viii 2009 leg. J. Kaize, Survey Kelompok Entomologi Papua, RMNH. The additional specimens became available very recently and were not used for the species description. They correspond very closely to the type specimen.

Differential diagnosis

The male can be distinguished from all other species of *Argiolestes* s.str. by the blue face, inferior appendages more than half the length of the superior appendages and the hind wing having four or five rows of cells between the anal vein and hind margin of wing. Female unknown.

Male holotype

Head: Labium brown with the anterior third dark brown to black. Front of face, including labrum, mandibles, genae, clypeus and anterior part of frons blue in life; anteclypeus slightly darker and lower posterior corner of genae black. A black line is present between postclypeus and frons. Blue colour extends along the margin of the eye, reaching the dorsum of the head, a crescent shaped blue spot is present on both sides of the median ocellus; remainder of head including antennae dull black.

Thorax: Prothorax dark, seemingly without pattern, posterior lobe of pronotum simple with rounded corners. Although the colour on the specimen is poorly preserved the pattern on synthorax is clearly visible on the photograph of the living specimen (Plate IIIa): front of synthorax dark; mesepimeron dark with a blue, short and thin streak along mesopleural suture and a median blue spot; metepimeron dark with lower anterior corner blue. — Coxae and trochanters pale brown, femora dark brown on the outside but pale brown on the inside, tibiae brown throughout. Inner side of femora not flattened. Spines black. Femora with respectively 8, 10, 13 spines laterally; tibiae of first pair of legs with six larger and eight smaller spines laterally; tibiae of second and third pair of legs laterally with 10, 13 spines respectively. — Wings: Fw and Hw tinted slightly brownish. Venation dark brown to black. Fw and Hw of equal length. One Fw with 2 and one with 3 Ax; Fw with 26-27 Px; Hw with 2 Ax and 22-23 Px. Arculus slightly proximal to level of Ax₂; discoidal cell in Fw long, costal side about twice as long as distal side, most acute angle about 40°. Ac proximal to Ax₁. Two cells between discoidal cell and subnodus. Pt brown. Most cells beyond Pt divided. Four or more rows of cells between anal vein and hind margin of Hw. Fields between IR₂ and R₃, between R₃ and IR₃, and between IR₃ and R₄ each containing three or more rows of cells distally.

Abdomen: S₁ black, S₂ with sides and posterior half black and latero-ventral side pale brown, S₃-7 black with a small latero-ventral brown spot anteriorly (bluish in life), S₈-9 black, S₁₀ black with the posterior one sixth pale blue. Hind margin of S₁₀ without spines and slightly depressed in the middle. Epiproct upturned and prominent in dorsal view. Superior appendages as in Figure 2d. Superior and inferior appendages white; inferiors ca 2/3 the length of superiors. Basal flange of superior appendages ca 1/3 the length of superior appendages and ends in a slightly upturned, interiorly directed angle. Lower apical flange of superior appendages moderately expanded and simple shaped, the upper flange far less prominent and visible mainly due to the black blunt denticles which it bears. Apical part of the lower apical flange divided from the apex of the appendages by a deep incision. The outer border of superior appendages with two to four moderately large spines. Inferior appendages long and slender (Fig. 3d) and largely covered by the superiors in dorsal view. Genital ligula as in Figure 4 with two very long and slender lateral horns.

Measurements [mm]: Total length 44, abdomen 35, Fw 28; Pt in Fw 1.6 (costal length), 2.0 (longest length); Pt in Hw 1.8 (costal length), 2.4 (longest length).

Ecological notes

The male holotype was taken perched on tangled vegetation above a small, steeply dropping tributary streamlet, feeding into a larger, clear, rocky stream on the western side of Roon Island. The entire stream catchment was covered in dense

primary rain forest, and showed little sign of human disturbance. Further details on the locality, where the additional specimens were collected, are not available. The species is only known from the islands Roon and Mioswaar. These islands were connected with the mainland during glacials and it is likely that the species also occurs on the mainland.

Key to the males of *Argiolestes* sensu stricto

1. Inferior appendages less than half the length of superior appendages 2
- 1'. Inferior appendages more than half the length of superior appendages 5
2. Superior appendages without inner basal flange 3
- 2'. Superior appendages with an inner basal flange, running along the axis of the appendages for a third or halfway the length 4
3. Epiproct not prominently visible in lateral view; outer border of superior appendages without a large spine; no long hairs on apex of superior appendages *A. celebensis*
- 3'. Epiproct large and upturned, well visible in lateral view; outer border of the superior appendages with a large spine; apex of the superior appendages bearing a tuft of conspicuous long hairs *A. tuberculiferus*
4. Front of synthorax bronze-black; mesepimeron with a wedge-shaped blue stripe that borders the humeral suture *A. australis*
- 4'. Front of synthorax blue; mesepimeron largely pale, without a well defined wedge-shaped blue stripe bordering the humeral suture *A. pallidistylus*
5. Front of synthorax with a pair of large, well-defined, marks 6
- 5'. Front of synthorax without a pair of large, well-defined, marks 7
6. Basal flange of superior appendages ends in a prominent interiorly directed, blunt tubercle (Fig. 2c). Lower apical flange of superior appendages strongly expanded inwards and with a clear angle making it triangular in shape *A. muller* sp. nov.
- 6'. Basal flange of superior appendages does not end in a prominent spine. Lower apical flange of superior appendages less strongly expanded and rounded *A. macrostylis*
7. Face, including labrum largely orange brown *A. alfurus*
- 7'. Face, including labrum largely blue 8

8. 4 or 5 rows of cells between anal vein and hind margin of wing; Fw with 25 or more Px *A. roon* sp. nov.
- 8'. Up to 3, but mostly only 1 or 2 rows of cells between anal vein and hind margin of wing; Fw with 26 or less Px 9
9. Inner margin of lower apical flange of superior appendages s-curved and apical half distinctly concave (Fig. 2a) *A. amphistylus*
- 9'. Inner margin of lower apical flange of superior appendages rounded and apical half not distinctly concave (Fig. 2b) 10
10. Seen from below: tip of the inferior appendages broadened and ending in simple shaped triangular area *A. obiensis*
- 10'. Seen from below: tip of the inferior appendages broadened and ending in triangular area with an anteriorly pointing angle (Fig. 3b) *A. foja* sp. nov.

DISCUSSION

Argiolestes s.str. as defined in this article contains 10 species. *A. celebensis* is the only species included in this group, in which the basal flange and the large spines on the superior appendages are lacking. It is still included in *Argiolestes* s.str., though with slight hesitation, because characters of the head of the genital ligula conform to the group discussed here. The group is distributed in New Guinea and on adjacent islands, the northern islands of the Moluccas, and on Sulawesi (Fig. 5). No records of this group are known from the eastern fourth of New Guinea although there are many records of *Argiolestes* species belonging to other groups.

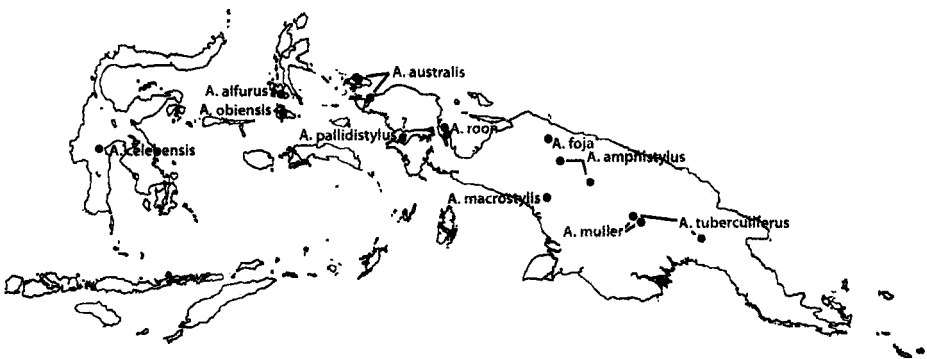


Figure 5: Distribution of the species included in *Argiolestes* sensu stricto.

Most species of *Argiolestes* s.str. seem to have small distributions and none is known from more than five records. The limited information on habitats of the species indicate that the larvae of *Argiolestes* s.str. probably live in seepages and small brooks in forest.

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